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(54) AN EMERGENCY BRAKE SYSTEM FOR AUTOMATIC COMPRESSED AIR BRAKES FOR RAILWAY CARRIAGES

(71) We, WERKZEUGMASCHINENFABRIK OERLIKON-BUHRLE AG, a company organised and existing under the laws of Switzerland of Birchstrasse 155, CH-8050 Zurich,

do hereby declare the invention for which we pray that a Patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

The invention relates to an emergency brake system for automatic compressed air brakes in railway carriages, in which the operation of an emergency brake handle causes the brake pipe to be vented and warning means to be activated, and in which the venting of the brake pipe is suppressed when an auxiliary valve operates.

The term "automatic compressed air brake" is used herein to mean a compressed air brake of the type which has a pressurised brake pipe and which is automatically applied when pressure is released from the brake pipe, for example if the pipe breaks or become uncoupled.

The object of the invention is to provide means in such an emergency brake system which will enable railway personnel and particularly the driver of the train, at his discretion to countermand the application of the emergency brake.

In an emergency brake system of the contemplated kind described in French Patent Specification No. 1 366 205 the auxiliary valve is operated after the main brake pipe has been fully exhausted. Since this happens only when the driver initiates an emergency application he cannot cancel such emergency brake application at any time he may desire. Such a cancellation of an emergency brake application may be desirable in particular cases in the interests of safety, for instance when the train is inside a tunnel, on a bridge, or on a single line track.

It is therefore an object of this invention to provide an emergency brake system of the above described kind in which when the warning means have responded the auxiliary valve can still be operated.

According to the invention, there is provided an emergency brake system for an automatic compressed air brake as hereinbefore defined for railway vehicles, in which the operation of an emergency handle causes the brake pipe to be vented and warning means to be activated, and in which the venting of the brake pipe can be stopped by operation of an auxiliary valve having a manually operable remote control means therefor.

The remote control means may be so designed that after operation it will automatically return into a position of rest in which the auxiliary valve is inactivated. This safeguards the emergency brake system against the remote control means being held by train peronnel for an excessively long period of time in a position cancelling an emergency brake application.

In a preferred embodiment of the invention the system includes a pneumatic piston controlling a switch for activating and inactivating the warning means, the piston having two different effective surface areas, the smaller surface area for urging the switch in closing direction being exposed to the pressure existing in the brake pipe, and the larger surface area being exposed to the pressure existing in a communicating pipe which is connected to the brake pipe and can be vented by the operation of the emergency brake handle, but which is cut off from the brake pipe when the auxiliary valve is operated. Because of this construction of the switch it is possible to provide that even after the cancellation of an emergency brake application the switch will be kept in closed position by the pressure in the brake pipe acting on the smaller surface area, the warning means thus remaining in the activated stat until the operated

emergency brake handle has been restored to its former position. The warning means will thus continue to remind the driver that an emergency brake application has been initiated. This is of particular importance when a holding means is associated with the auxiliary valve and permits the driver to release the remote control means without thereby nullifying the cancellation of the emergency brake application.

The invention includes a railway vehicle having an automatic compressed air brake as hereinbefore defined, including the emergency brake system of the invention. The vehicle may have a passenger-carrying compartment and a driver's compartment, the emergency handle being located in the passenger-carrying compartment and the manually operable remote control means for the auxiliary valve being located in the driver's compartment. The invention also includes a railway train comprising a carriage and a locomotive, and having an automatic compressed air brake as hereinbefore defined, which brake includes an emergency brake system in which the operation of an emergency handle located in the carriage causes the brake pipe to be vented and warning means located in the locomotive to be activated, and in which the venting of the brake pipe can be stopped by operation of an auxiliary valve located in the carriage, the auxiliary valve having a manually operable remote control means therefor located in the locomotive.

Several embodiments of the emergency brake according to the present invention will now be described in greater detail with reference to the accompanying drawings in which:—

Figure 1 illustrates a first embodiment of the proposed emergency brake system in which the signalling means are operable by a differential piston,

Figure 2 illustrates a second embodiment of the proposed emergency brake system in which the signalling means are operable by the emergency brake valve,

Figure 3 illustrates a third embodiment of the proposed emergency braking system in which the signalling means can be kept in the activated state by a holding relay,

Figure 4 illustrates a fourth embodiment of the proposed emergency brake system, comprising a pneumatic holding means for the auxiliary relay,

Figure 5 illustrates a fifth embodiment of the proposed emergency brake system comprising an electrical holding circuit associated with the auxiliary relay.

Referring to the first embodiment illustrated in Fig. 1, an emergency brake valve 11 is connected to the brake pipe 10 in the equipment of a railway carriage shown on the right side of a dot-dash line. The emergency brake valve 11 contains a chamber 12 which directly communicates with the main brake pipe 10, and which can be shut off from a vented chamber 14 by a valve disc 13. The valve disc 13 is attached to a piston 15 which separates two chambers 16 and 17. The lower chamber 16 communicates through a choke 18 with the valve chamber 12, whereas the upper chamber 17 likewise communicates with chamber 12 through a second choke 19. A spring 20 contained inside the upper chamber 17 bears on piston 15 and seeks to keep the valve disc 13 on its seat and the valve 11 closed. The upper chamber 17 further communicates with a chamber 22 of the auxiliary valve 21. Chamber 22 can be shut off from a second chamber 24 by a valve disc 23. The latter is operable by the plunger of a solenoid 25. A spring 26 keeps valve 21 open when the solenoid 25 is not energised. A pipe 28 connects the second chamber 24 to a number of emergency brake handle boxes 27. The drawing shows only one such emergency box 27, but in practice a box would be provided in every compartment of a railway carriage, whereas only one emergency brake valve 11 would be installed in each carriage. Each emergency brake box 27 has an emergency handle 29 which is connected by a linkage to the stem 72 of a valve disc 30. A locking bolt 84 is slidable in a bearing extending at the bottom of the emergency box 27 at right angles to the valve stem, and a spring 85 attached to the emergency box urges the bolt into contact with a stop 71 on the valve stem 72. The valve disc 30 can be lifted off its seat against the resistance of spring 31 by the pulling of the emergency handle 29. The stop 71 will then force the bolt 84 back against the thrust of its spring 85 in order to clear the end of the bolt. When this is the case the spring 85 can restore the bolt 84 to its former position but it will now engage the underside of the stop 71 thereby locking it in raised position in which the valve 30 remains open. The compressed air in pipe 28 and in chamber 22 and 24 of the auxiliary valve 21 will therefore exhaust to atmosphere through the open valve 30.

The arrangement further comprises an electro-pneumatic switch 38 having a differential piston 32 which divides off two chambers 34 and 35 in a cylinder 33, chamber 34 communicating through a branch pipe 36 with the brake pipe 10 and the other chamber 35 through another branch pipe 37 with the connecting pipe 28. The piston 32 is attached to a plunger 80 which extends through a sealed opening 81 and which carries an arcuate spring bridging contact 82 which bears against a stop member 83. When the switch is closed

the driver operating switch 43.

In the case of the third embodiment illustrated in Fig. 3 the emergency brake valve 11, the auxiliary valve 21 and the emergency brake handle boxes 27 are again constructed exactly as in the second embodiment illustrated in Fig. 2. Merely the remote control system in this third embodiment is different from that in Fig. 2.

The piston 15 is adapted to operate a switch 45 which serves for energising the windings 47 of a holding relay 48. The holding relay 48 has two working contacts 49 and 50. Contact 49 permits the windings 47 to be further supplied with current after switch 45 has been reopened. Contact 50 switches on the signalling lamps 39 and 68. Finally an electrical switch 51 is provided alongside the holding relay 48 in parallel to switch 45. When switch 51 is opened the circuit through windings 47 which has been kept closed by contact 49 is cut off so that the holding relay 48 releases and the signalling lamps 39 and 68 go out.

In this embodiment according to Fig. 3 the displacement of piston 15 when an emergency brake handle 29 has been pulled cannot be prevented. The displacement of the piston 15 closes contact 45. Consequently the winding 47 of the holding relay 48 will be energised and contacts 49 and 50 will close. Contact 50 operates to activate the signalling lamps 39, 68. Should the train be on a critical section where emergency braking should be avoided, the driver can act by pressing switch 43. Contact 49 keeps the electromagnet 47 energised until switch 51 is opened.

In the embodiment according to Fig. 4 the system installed in the carriage, which is that on the right hand side of the dot-dash line 76 in the drawing, again comprises the emergency brake valve 11 containing a chamber 12 in direct communication with the main brake pipe 10 which extends throughout the length of the train. Chamber 12 can be vented through an outlet 14 controlled by a valve comprising a fixed valve seat 9 and a moveable valve member 13. A valve stem 6 rigidly connecting the valve member 13 to an actuator piston 15 loaded by a spring 20 slidably passes through a hole provided with sealing means in an intermediate wall 8 of the valve casing 7. Piston 15 separates a chamber 16, which communicates with chamber 12 through a choke 18, from an upper chamber 17. The latter also communicates with chamber 12 through pipe 5 containing a choke 19 of smaller diameter than that of the choke 18.

A pipe 28' branches off pipe 5 and leads to a chamber 77 in the auxiliary valve 21. This branch pipe forms part of the pipe line connecting the emergency brake handle boxes 27 to the emergency brake valve 11. Chamber 77 contains a slidably movable piston 78 in the upper reduced face 53 of which a rubber pad 54 is inserted. A spring 55 loads piston 78 urging it against a partition 56 in the valve body 57. A bore 58 provides communication between chamber 77 and the space between the underside of the piston 78 and the partition 56. Hence the pressure on both sides of the piston 78 will always be the same. In the middle of the top of the valve 57 is a valve seat 59 facing the rubber pad 54 and surrounding a bore 61 with an enlarged end.

The partition 56 contains a sealed slide bearing 62 which is coaxial with the valve and contains a push rod 63. The push rod extends upwards to the underside of piston 78 and carries a soft iron plunger 64 which can rest on the bottom of the valve body 57, and which is surrounded by the winding 65 of a solenoid. A conductor pair 66 connects the winding 65 to two wires 40 and 41 of a four-wire cable 67 which extends the entire length of the train. When the winding 65 is energised the plunger 64 together with the push rod 63 is pulled upwards, the push rod striking the piston 78 and pushing it up against the valve seat 59.

The bore 61 in valve 21 is directly connected to that part 28 of the compressed air pipe which provides communication between the several emergency brake handle boxes 27 and the emergency brake valve 11. Each emergency box 27 of which there are several in each carriage contains a chamber 74 and a seat 73 for a valve member 30. A push rod 72 carrying a truncated cone-shaped head 71 and slidably mounted in the valve axis projects into the seat 73, the bottom end of the push rod being linked to a two-armed lever 70. This lever 70 which is centrally pivoted carries a handle 29 and is loaded to remain in the position of rest as shown by a spring not shown in the drawing. Slidably mounted in a guideway at right angles to the valve axis at the bottom of the emergency box 27 is a bolt 84 which is urged by a spring 85 attached to the box against the coned push rod head 71. When the emergency handle 29 is pulled the push rod 72 will strike the valve member 30 and lift it off its seat 73. The coned head 71 engages the end of the bolt 84 and thrusts it aside against the resistance of its spring 85 until the head is clear of the bolt. When this is the case spring 85 pushes the bolt back again underneath the coned head 71 which is thus locked in raised position to keep the valve 30, 73 open. The valve cannot be reclosed by its loading spring 31 until the bolt 84 has been withdrawn by hand.

The signalling equipment for signalling the operation of an emergency brake handle

the bridging contact 82 bridges the two contacts of a contact pair 86 connected to a pair of electric leads 40, 42. Owing to the presence of the plunger 80 the effective surface area of the piston 32 facing the pressure in chamber 34 is much smaller than the effective surface facing the pressure in chamber 35.

The bridging contact 82 operates to activate a signalling lamp 68 in the locomotive by completing a circuit from a positive wire 40, 42 through the lamp to a negative wire 41. Several lamps 68 simultaneously glow which are all connected in parallel between wire 42 and wire 41.

A manual electric switch 43 forming a remote control permits the solenoid 25 of the auxiliary valve 21 to be energised and de-energised. Switch 43 is likewise located in the locomotive. It is fitted near the signalling lamp 68 and remains in closed position as long as operated by the driver.

The described brake system functions as f llows:—

When the train is in motion and the brakes are off the brake pipe 10 contains the normal service pressure and this pressure also exists in chamber 12 of the emergency brake valve 11. Owing to the provision of the chokes 18 and 19 the same service pressure will also exist in chambers 16 and 17 of the emergency brake valve 11. In other words, the pressures on the two sides of piston 15 will be equal. The spring 20 of the emergency brake valve 11 will therefore keep the valve disc 13 firmly on its seat and no air can escape from the main brake pipe 10 to atmosphere. The auxiliary valve 21 is open because the solenoid 25 is not energised and spring 26 pushes the valve disc 23 off its seat. Consequently the connecting pipe 28 will fill with compressed air through the chokes 19 and through valve 21.

Let it now be assumed that one of the emergency brake handles 29 has been pulled. This means that valve disc 30 will have been lifted off its seat against the resistance of its loading spring 31 and the connecting pipe 28 will now be exhausted. Since the choke 19 prevents a rapid admission of air, chamber 17 will also be exhausted and piston 15 will lift valve 13 off its seat by the pressure in chamber 16 overcoming the resistance of spring 20.

However, before this can happen the pressure in chamber 35 on one side of the differential piston 32 will have dropped sufficiently f r the piston to be displaced by the pressure in chamber 34 and the electric switch 38 to be closed. Consequently all the signalling lamps 39 and 68 will gl w.

If the train at this instant happens to be on a critical track section where an application of the emergency brake sh uld be avoided, the driver will press switch 43. This will cause the auxiliary valve 21 to close, permitting the pressure in the brake pipe 10 to be restored in chamber 17 through the flow restriction 19. The application of the emergency brake is thus countermanded.

In the second embodiment in Fig. 2 an emergency brake valve 11 is connected to the brake pipe 10. This emergency brake valve is substantially of the same construction as that in the first embodiment illustrated in Fig. 1 i.e. the chamber 12 which directly communicates with the brake pipe 10 is shut off from the outlet chamber 14 by a valve disc 13. The piston 15 attached to the valve disc divides off the two chambers 16 and 17, the bottom chamber 16 communicating with the valve chamber 12 through a choke 18, whereas the upper chamber 17 communicates with chamber 12 through a second choke 19. The spring 20 which is contained in the upper chamber 17 urges the piston 15 downwards to keep the valve disc 13 on its seat and the valve closed.

However, contrary to the previous embodiment piston 15 is also adapted to operate an electrical switch 44. This switch 44 functions in the same way as does switch 38 in the previous embodiment to activate signalling lamps 39 and 68 by completing a circuit through positive wires 40, 42 and a negative wire 41.

In analogous manner to the previous embodiment an auxiliary valve 21 is associated with the emergency brake valve 11. Again chamber 22 is connected to chamber 17 of the emergency brake valve 11 and separable from the second chamber 24 by a valve disc 23. Valve disc 23 is operable by a solenoid 25. The spring 26 seeks to keep the valve 21 open for as long as the solenoid 25 is not energised.

Again a number of emergency brake handle boxes 27 are connected to the second chamber 24 of the auxiliary valve 21 by a connecting pipe 28. The solenoid 25 of the auxiliary valve 21 can be energised by the driver through an interposed time delay relay 52, which closes the auxiliary valve for a pre-determined period of time, by closing a switch 43 normally held in open position by a spring 43*a*.

In the embodiment according to Fig. 2 the displacement of piston 15 when an emergency brake handle 29 has been pulled cannot be prevented. The displacement of the piston causes the electrical switch 44 to be closed and the signalling lamps 39, 68 to light up. Should th train happen to be running on a critical section where emergency braking should be avoided, the application of the brakes can be prevented by

Should the driver wish to release the brakes he can do this by briefly pressing the push button switch 43. All the valves 21 in the train will then respond to the potential pulse transmitted through wire 40 and valve 54, 59 will close. In that carriage in which an emergency brake handle had been pulled the closure of this valve causes the pressure in chamber 77 to rise again because the supply of compressed air to the brake pipe 10 builds up a static pressure in chambers 12 and 16 of the emergency brake valve 11, as already described. In all those carriages in which no emergency brake handle had been pulled the valves 21 will reopen immediately the signal pulse has ended. However, the valve in that carriage in which the emergency brake handle had been pulled will remain closed. This is so because when piston 78 covers the valve seat 59 the surface embraced by the seat is exposed to atmospheric pressure due to pipe 28 having been vented. Part of the top 53 of piston 78 is thus relieved of the pressure existing inside chamber 77. Owing to the pressure transmitted through the bore 58 to the underside of the piston the latter will be subject to a resultant thrust which keeps it in contact with the valve seat against the resistance of spring 55. This valve 21 therefore remains closed until such time as the pressure in chamber 77 drops to atmospheric. When this is the case spring 55 will reopen the valve. Owing to the continued supply of compressed air to the brake pipe 10 after valve 21 had closed the pressure in the brake pipe 10 will be restored to the service pressure and the brakes throughout the train will release. In chambers 16 and 17 of the emergency brake valve 11 the pressure will also rise to the service pressure. Not withstanding the delay in the filling of chamber 17 in relation to chamber 16 due to the effect of the choke 19 the valve, as already mentioned, will be kept closed by spring 20. The lamps 39 and 68 which continue to glow remind the driver that an emergency brake handle had been pulled in one of the carriages of the train. On the other hand, the personnel accompanying the train can easily locate the particular emergency box, since only that lamp 39 will glow which belongs to the carriage where the emergency handle is down.

In order to restore the emergency brake equipment to its normal service position the engine driver must carry out an emergency brake application in rder to vent the brake pipe 10 without supply of compressed air t this pipe and he must thus bring the train to a rapid stop. In such a case the pressure in chambers 34 of the pneumatic switch 38 and 12 of the emergency brake valve 11 will drop to atmospheric pressure. This pressure drop is transmitted subject to the delay caused by the choke 19 through pipe 28 to chamber 77 of valve 21 and this valve will therefore be pushed into its open position by spring 55, as already described. Moreover, the bolt 84 in the operated emergency brake handle box must now be withdrawn against the resistance of its spring 85 and allowed to bear against the coned head 71 which will drop back into position of rest as soon as it is released by the bolt. The valve 30, 73 is therefore reclosed by its spring 31 and pipe 28 ceases to be in communication with the atmosphere. When the main brake pipe 10 is then recharged the switch 38 will also return into the position shown in the drawing and the lamps 39 and 68 will go out.

The embodiment in Fig. 5 merely differs from that described with reference to Fig. 4 in the particular construction of the auxiliary valve 21. All the other parts of the emergency brake equipment correspond exactly to the corresponding parts of the embodiment in Fig. 4, as already described. Like parts in both drawings are therefore identified by like reference numbers.

The push rod 63 in valve 21 in Fig. 5 is rigidly connected to a valve member 87 and at its bottom end it carries a contact element 88 which is adapted to establish an electrical connection between two fixed contacts 89. The winding 65 of the solenoid is connected by a conductor pair 66 to the two wires 40 and 41 of the electric cable 67 which extends from end to end of the train. That conductor of the pair 66, which is connected to wire 40 is also connected to one contact of the pair of contacts 89, whereas the other contact of this pair is connected by a conductor 90 to one contact of a second pair of contacts 91 and thence by a lead 92 to one contact of a third pair of contacts 99. The second pair of contacts form part of a pneumatically controlled switch 93 which has a pressure chamber 94 connected by a branch pipe 95 to chamber 12 in the emergency brake valve 11.

Chamber 94 slidably contains a piston 97 which is loaded by a spring 98 and to which a bridging contact 96 is attached. The third pair of contacts 99 of which the second contact is connected by a conductor 100 to wire 42 in cable 67, forms part of the pneumatic switch 38. The push rod 80 of this switch carries not only the bridging contact 82 for cooperation with the contact pair 86 but also a second bridging contact 101 which is adapted t establish an electrical connection between the pair f contacts 99. Switch 38 is a so-called snap-action two-position switch which is spring-retained in open as well as in closed position, although this is not shown in the drawing.

The manner in which the emergency

box 27 comprises an electric lamp 39 in each carriage and a lamp 68 in the driver's cab of the locomotive. All the lamps 39 in the carriage are individually connected by a pair of conductors 79 through an associated pneumatic switch 38 to a wire 42 and directly to a wire 41 of the electric cable 67. However, the lamp 68 in the driver's cab is connected to a wire 75 which is in turn connected in each carriage through an interposed diode 69 to the conductor 79 leading to the signalling lamp 39 in the carriage. Also located in the driver's cab is a push button switch 43 of which one pole is connected to a current source indicated by + and −, whereas the other pole is connected to wire 40 of cable 67. The wires 41 and 42 in cable 67 are directly connected to the − and + terminals of the source.

Switch 38 contains a piston 32 which is sealingly slidable inside a hollow cylinder 33, and which divides the interior into two chambers 34 and 35. Chamber 34 is directly connected to the main brake pipe 10 by a pipe 36, whereas chamber 35 communicates through a pipe 37 with the pipe 28 interconnecting the several emergency brake handle boxes 27. The piston 32 has a neck 80 which is slidable in a slide bearing 81 and carries a resilient contact bridge 82 normally resting on a fixed stop member 83. In operative position the bridge 82 connects the contacts 86 of a pair to which the conductor pair 79 is attached. The presence of the neck 80 has the effect of reducing the effective cross section of the piston 32 facing the pressure in chamber 34 below that of the cross section facing the pressure in chamber 35.

The emergency brake system which in Fig. 4 is represented on the assumption that it is in a fully unpressurised state functions as will now be described. If the brake pipe 10 carries no pressure the emergency brake valve 11 will be kept closed by spring 20, whereas the pneumatic switch 38 will be open. It is further assumed that the emergency brake handle boxes 27 are in their normal positions, as illustrated, and that the valves 30, 73 are therefore all closed. The push button switch 43 is open, as shown, when not operated. Consequently wire 40 of cable 67 will be at zero potential, the windings 65 will not be energised and the valves 21 will be in open position due to the thrust of their springs 55.

When the brake pipe 10 is filled to service pressure chamber 34 of switch 38 will also be pressurised through pipe 36, whereas chamber 35 will fill only at the rate permitted by the choke 19 through the open valve 21 and pipe 37. Owing to the considerable difference between the effectiv surface areas of the two faces f piston 32 the resultant thrust will be in the direction tending to push the bridge contact 82 away from the contact pair 86. Switch 38 therefore remains open and the lamps 39 and 68 do not light up. Chamber 17 of the emergency brake valve 11 fills more slowly than chamber 16 because of the smaller cross section of the choke 19 compared with that of the choke 18. Nevertheless the overriding effect of the spring 20 keeps the valve closed.

A service or emergency application of the brakes under the driver's control by lowering the pressure in the brake pipe 10 does not in any way affect the emergency brake system.

When the handle of one of the emergency boxes 27 is pulled, the corresponding valve 30, 73 will be opened, and hence chamber 74 and the air pipe 28 vented to atmosphere. The bolt 84 will engage, as above described, under the push rod head 71 and lock the valve 30, 73 in open position. Through pipe 28 chamber 35 of switch 38 will also be vented. The pressure in chamber 34 will therefore now shift piston 32 upwards for closing the switch 82, 86. This completes a circuit from wire 42 through switch 38 to lamp 39 and thence to wire 41, so that the lamp 39 in the carriage in which the emergency handle has been pulled will light up. At the same time the diode 69 allows the lamp 68 in the driver's cab to light up, thus reporting the operation of one of the emergency brake handles. The lamps in other carriages remain without potential since no current can flow from wire 75 through the diodes in blocking direction.

Another result of the venting of the air pipe 28 is the rapid exhaustion of chamber 17 of the emergency brake valve 11 accompanied by the delayed exhaustion of chambers 12 and 16 through the choke 19. The consequent generation of a pressure difference between chambers 16 and 17 creates a thrust on piston 15 which overcomes the counterthrust of spring 20 and opens the valve 11. The brake pipe 10 is therefore rapidly vented through the outlet at 14 which is not throttled, and an emergency brake application is thus initiated. When the pressure in chamber 12 has dropped to a given level, the spring 20 is again able to force the piston 15 downwards and to reclose the valve. The supply of compressed air to the brake pipe for maintaining the pressure therein, which then takes effect from the locomotive, increases the pressure in chambers 12 and 16, causing valve 11 once again to open. The valve member 13 will finally occupy a steady position in which the valve is slightly open and thus functions as a flow restricting device. Consequently a low static pressure will remain in chambers 12 and 16.

the brake pipe is exhausted.

9. An emergency brake system according to claim 1, 2, 7 or 8, having an electrical holding circuit containing a solenoid winding for operating the auxiliary valve, and including a first switch controlled by the auxiliary valve, a second switch controlled by the pressure in the brake pipe and a third switch controlled by the pressure differential between the brake pipe and the communicating pipe which is connected to the vent valve.

10. An emergency brake system according to claim 2, having a pneumatic switch operable by a differential pressure piston for activating the warning means and in which the piston is exposed to the opposing pressures of the brake pipe and a part of the communicating pipe, said pipe part being separable from the chamber by the auxiliary valve.

11. An emergency brake system according to claim 10, in which the pneumatic switch is a snap-action two-position switch which by overcoming spring resistance can move from a rest position to a position activating the warning means.

12. An emergency brake system according to claim 10 or 11, in which the piston of the pneumatic switch has a face of small area exposed to the pressure of the brake pipe urging the piston to close the switch and a face having a larger area which is exposed to the pressure in the part of the communicating pipe which can be cut off from the chamber by the auxiliary valve.

13. An emergency brake system for an automatic compressed air brake for railway vehicles substantially as described herein with reference to the accompanying drawings.

14. A railway vehicle having an automatic compressed air brake as hereinbefore defined, which includes an emergency brake system according to any preceding claim.

15. A railway vehicle according to claim 14, which has a passenger-carrying compartment and a driver's compartment, the emergency handle being located in the passenger-carrying compartment and the manually operable remote control means for the auxiliary valve being located in the driver's compartment.

16. A railway train comprising a carriage and a locomotive, and having an automatic compressed air brake as hereinbefore defined, which brake includes an emergency brake system in which the operation of an emergency handle located in the carriage causes the brake pipe to be vented and warning means located in the locomotive to be activated, and in which the venting of the brake pipe can be stopped by operation of an auxiliary valve located in the carriage, the auxiliary valve having a manually operable remote control means therefor located in the locomotive.

17. A railway train according to claim 16, and in which the emergency brake system is an emergency brake system as claimed in any of claims 2 to 13.

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brake system according to Fig. 5 functionally differs from that according to Fig. 4 will now be described. The switch 93 is kept open by spring 98 so long as chamber 94 is not pressurised. When the brake pipe 10 is charged to service pressure this pressure will be transmitted through chamber 12 of the emergency brake valve and the pipe branches 5 and 95 into chamber 94 of switch 93, so that this switch closes. When an emergency brake application is initiated by the handle of one of the emergency brake boxes 27 having been pulled, the pressure in chamber 12 drops to a low level, as the brake pipe 10 continues to be supplied with compressed air as previously described, but the residual pressure is still sufficient to keep switch 93 closed. When switch 38 responds a further consequence of the pulling of the handle of one of the emergency brake boxes 27 is that besides contacts 86 the contact pair 99 will also be bridged. This prepares an electrical holding circuit for valve 21 which runs from wire 42 in cable 67 through conductor 100, contact pair 99, conductor 92 and contact pair 91.

Assuming now that the driver briefly depresses the push button switch 43 and thus sends a voltage pulse through wire 40 in cable 67, then this pulse will also flow through the solenoid winding 65 via conductor 66, and consequently the plunger 64 will be lifted to close valve 87, 59. At the same time the bridging contact 88 will establish an electrical connection between the two contacts 89, so that the above mentioned holding circuit is complete. This keeps valve 21 closed until switches 38 and 93 are reopened, and thus brings about the release of the brake, as already described with reference to Fig. 4. Valve 21 is therefore electrically held in closed position without a higher pressure having to be applied to one side of the valve member 87 than to the other. If the engine driver then initiates an emergency brake application, the pressure in the brake pipe 10 and hence in chambers 12, 34 and 94 will drop to atmospheric pressure. Switch 93 will therefore be opened by its spring 98 and the holding circuit through the two serially connected switches 93 and 38 will be broken. The valve member 87 will be returned by its spring 55 into its former position and thus re-establish communication between the two pipe portions 28 and 28'. As switch 38 is a snap-action two-position switch it continues to remain in closing position although there is no pressure in either of its associated chambers 34 and 35. This switch does not return into its starting position in which the lamps 39 and 68 are extinguished until the brake pipe 10 is recharged.

WHAT WE CLAIM IS:—

1. An emergency brake system for an automatic compressed air brake as hereinbefore defined for railway vehicles, in which the operation of an emergency handle causes the brake pipe to be vented and warning means to be activated, and in which the venting of the brake pipe can be stopped by operation of an auxiliary valve having a manually operable remote control means therefore.

2. An emergency brake system according to claim 1, in which the brake pipe is vented through an emergency brake valve having an actuating piston for operating the valve and a chamber closed by said piston, and further having a vent valve operable by said emergency brake handle for venting said chamber, in which the auxiliary valve when operated interrupts a communicating pipe between the chamber and the vent valve.

3. An emergency brake system according to claim 2, having an electric switch connected to the actuating piston of the emergency brake valve for activating the warning means.

4. An emergency brake system according to claim 1, 2 or 3 having a time delay relay operable by the remote control means and which, when operated, closes the auxiliary valve for a pre-determined period of time.

5. An emergency brake system according to any preceding claim, in which the remote control means comprises a switch which can be closed against the force of a spring.

6. An emergency brake system according to claim 3 having an electrical relay operable by the electric switch, the relay having a holding circuit which can be broken by a manually operable switch.

7. An emergency brake system according to claim 2, in which the valve member of the auxiliary valve forms a part of a piston which is slidably displaceable in a pressure chamber and which is exposed on both sides to the pressure existing in the pressure chamber, the side of the piston which when loaded would tend to open the valve being partly relieved of the pressure in the pressure chamber by means of the communicating pipe when the auxiliary valve is closed and the emergency brake handle has been pulled.

8. An emergency brake system according to claim 1, 2 or 7, in which the auxiliary valve is provided with a holding means for keeping the valve in a close position and that the holding means is adapted to be automatically activated upon the consecutive operation of an emergency brake handle and of the remote control means and to be automatically inactivated when

1527 815
5 SHEETS

COMPLETE SPECIFICATION

FIG.1

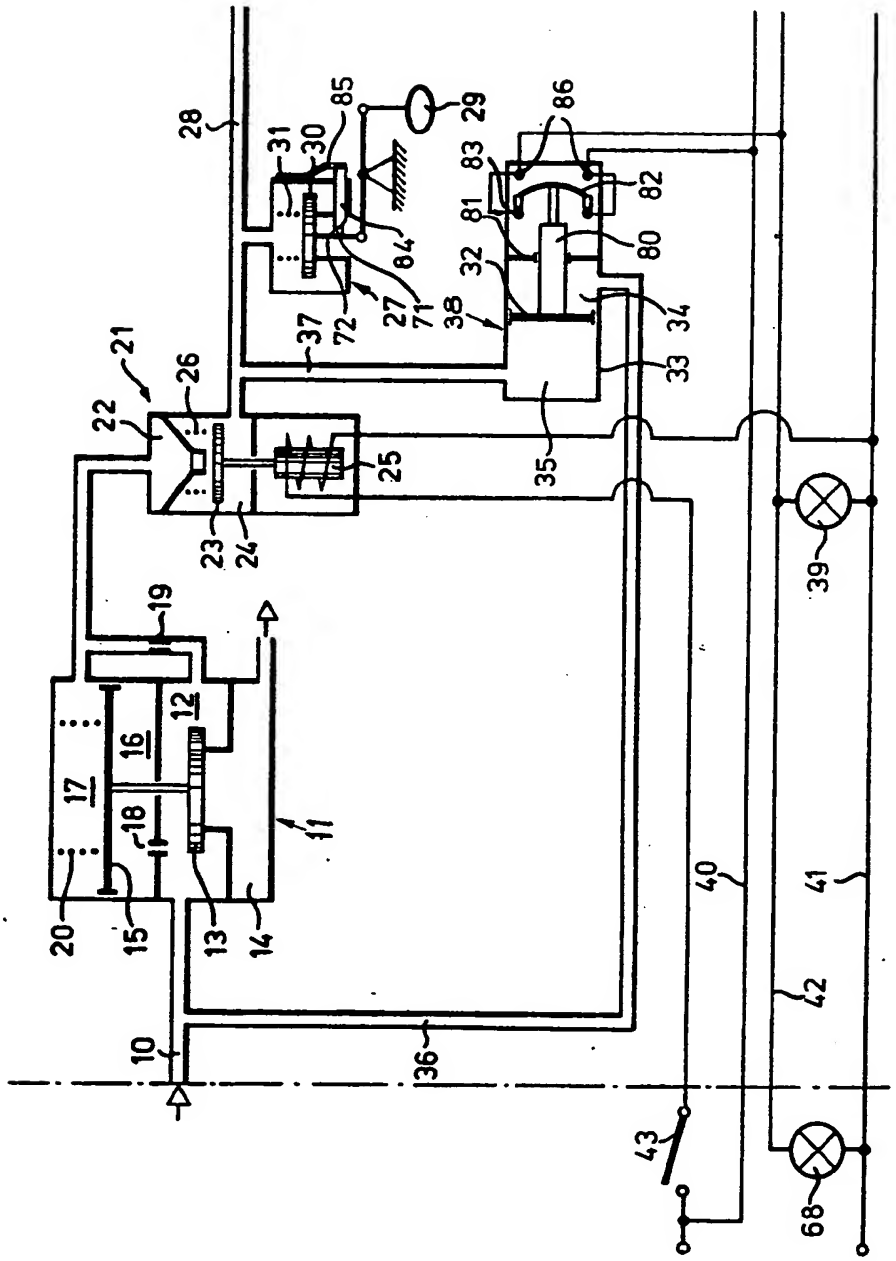

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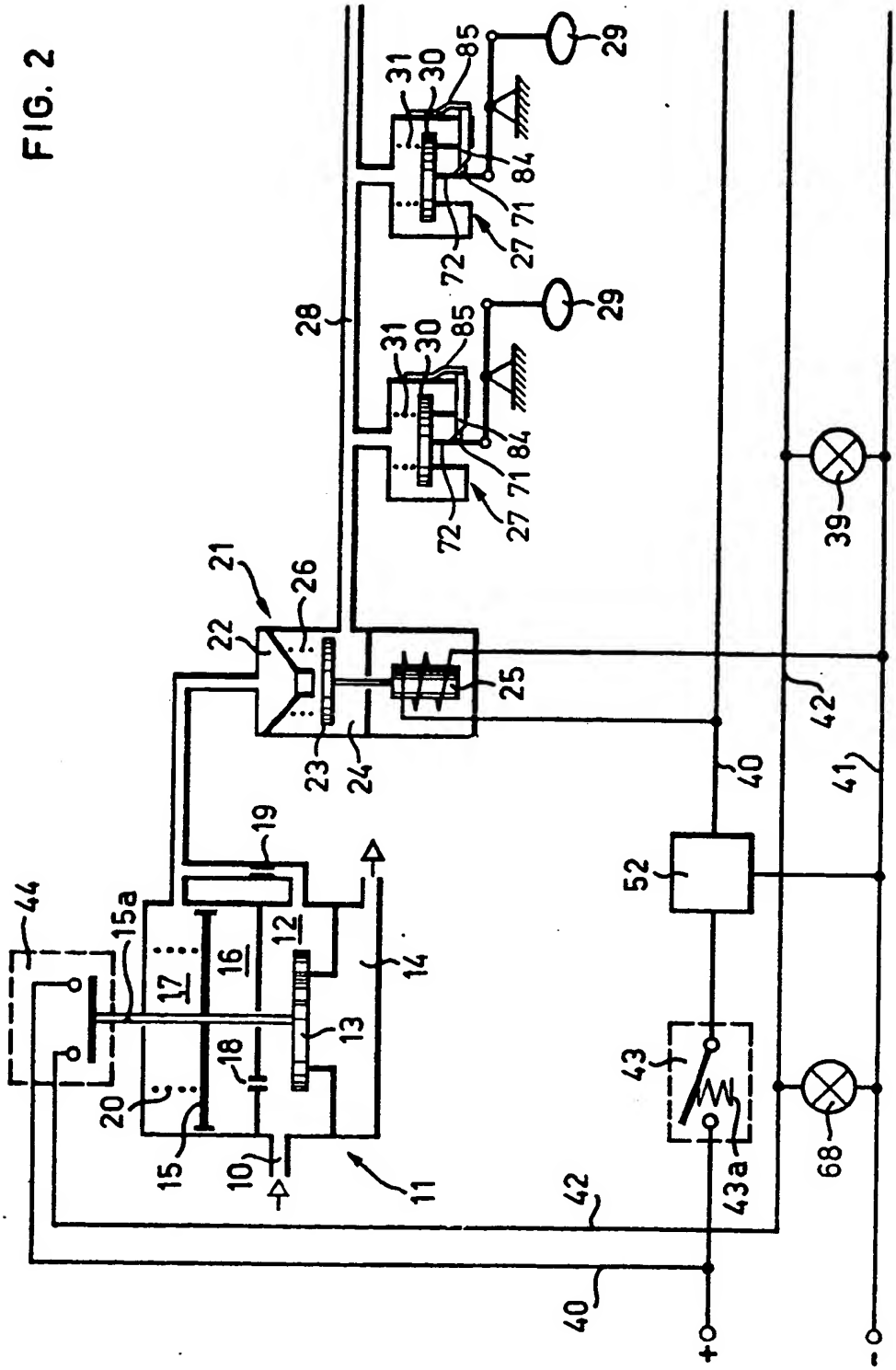
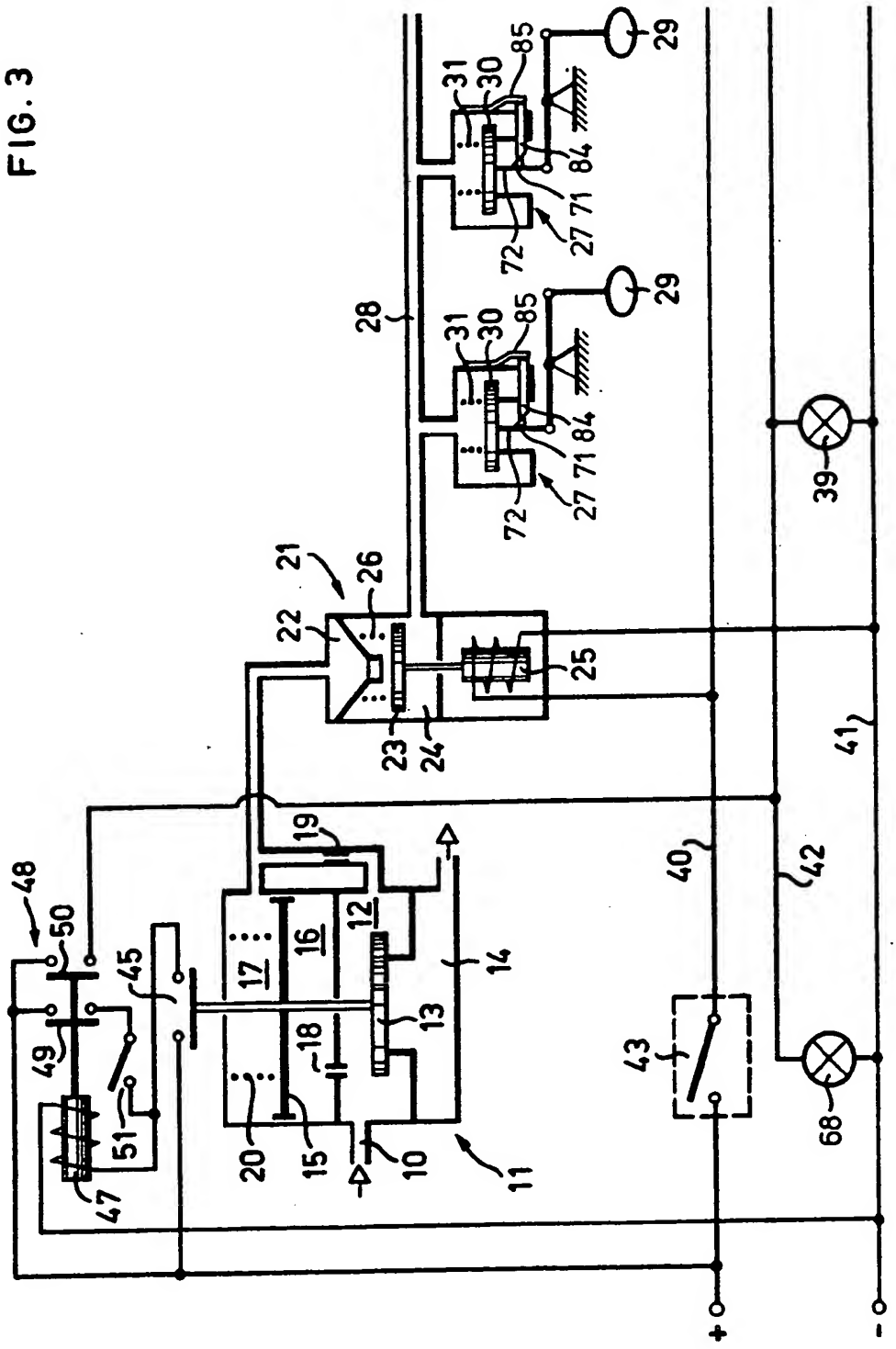
FIG. 2



1 527 815 COMPLETE SPECIFICATION
5 SHEETS

FIG. 3



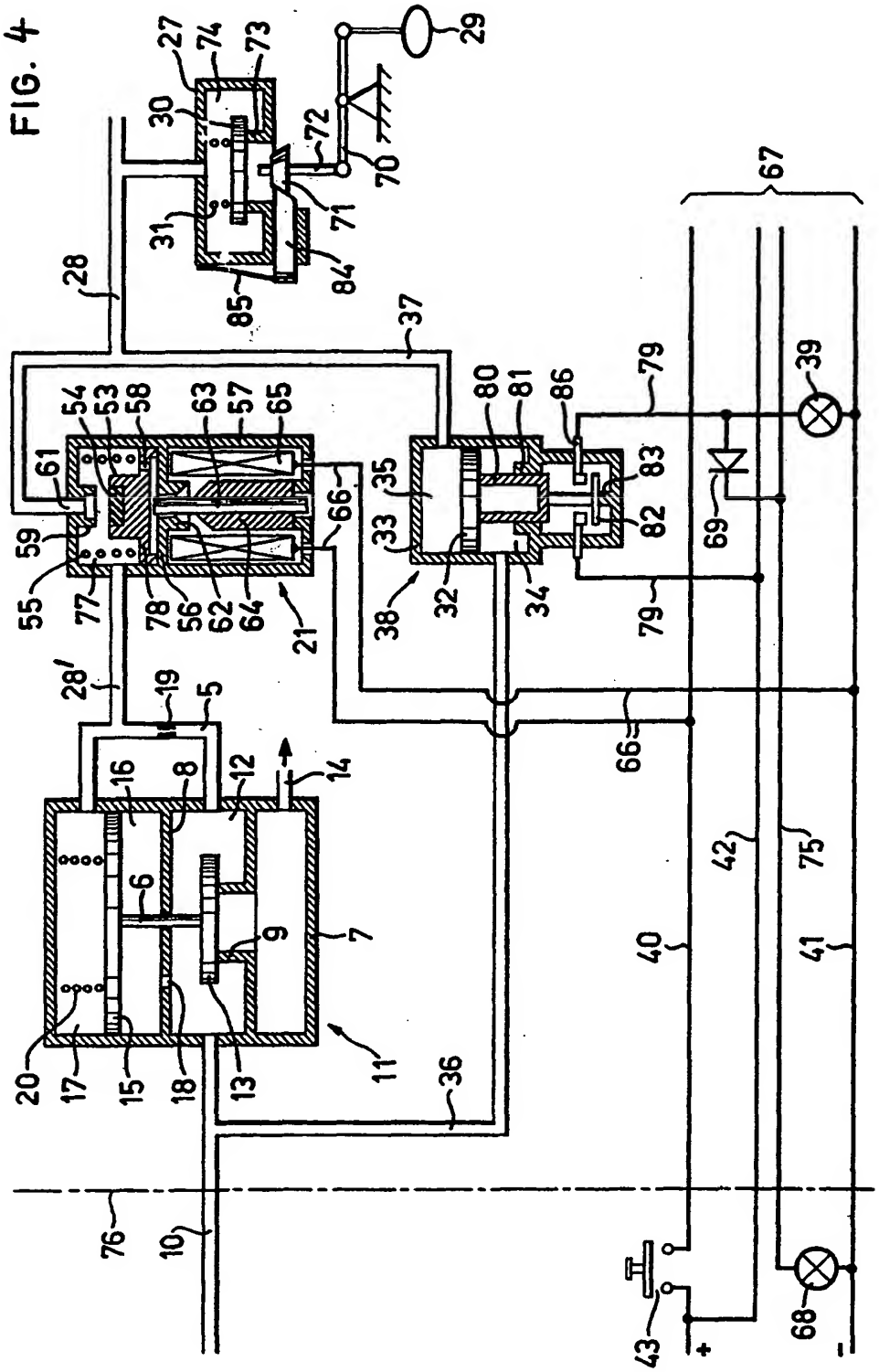
1527 815
5 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.

SHEET 4

FIG. 4



1527 815 COMPLETE SPECIFICATION
5 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEET 5

FIG. 5